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THREE INTELLIGENCE MEASURES: A COMPARATIVE ANALYSIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THREE INTELLIGENCE MEASURES: A COMPARATIVE ANALYSIS submitted by Philomena Joan McKenzie in partial fulfilment of the requirements for the degree of Master of Education in Counseling Psychology.

To My Parents

ABSTRACT

The Wechsler Adult Intelligence Scale-Revised (WAIS-R), the Standard Progressive Matrices (SPM), and the Shipley-Institute of Living Scale (SILS), were administered in a random order to a sample of 94 individuals. The purpose of the study was to examine the following research questions:

1. Is the relationship between the WAIS-R subtests and the Standard Progressive Matrices the same for all individuals?
2. Does the Shipley-Institute of Living Scale give an accurate estimate of WAIS-R Full Scale IQs?
3. Does the Standard Progressive Matrices give an accurate estimate of WAIS-R Full Scale IQs?

Multivariate and univariate statistical techniques were used to answer the above questions.

The results of the analyses provided some intitial evidence to support the hypothesis that the Standard Progressive Matrices does not measure one single dimension or ability, but rather that its function as an assessment tool could vary depending upon the population with which it is used.

The utilization of the Standard Progressive Matrices as a brief intelligence measure was deemed inappropriate as the results indicated only a moderate correlation with the WAIS-R Full Scale IQ. As well, for some individuals a significant relationship between the Standard Progressive

Matrices and the WAIS-R IQ scores was not obtained.

The Shipley-Institute of Living Scale has gained wide usage in educational and institutional settings as a brief intelligence measure. Tables available for converting the SILS scores into an IQ equivalent are based on research with the WAIS. The results from the study indicated that the SILS IQ equivalents overestimated the WAIS-R Full Scale IQ, and that the IQ scores were less variable than were the WAIS-R Full Scale IQs.

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CHAPTER I

INTRODUCTION

Wechsler has defined intelligence as "the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (Matarazzo, 1972, p.79). It can be seen as goal-directed, adaptive behavior that is a social and cultural product which will inevitably reflect social and cultural values (Sternberg, 1982). Intelligence can present itself in different ways depending upon the challenges of the situation, and the individual assets the person brings to the situation. It is not a unique entity but a composite of traits and abilities. These abilities are qualitatively differentiated but are not entirely independent.

Most intelligence instruments involve a combination of subtests that measure these different abilities. The abilities involved in performing tasks on the subtests serve as a test of intelligence because they have been shown to statistically relate to a culturally accepted definition of intelligent behavior; not because they constitute intelligence or that they represent the only way intelligence can be expressed.

The fact that intelligence tests do combine subtests measuring different abilities into a single intellectual

measure presupposes a certain common element among them. Charles Spearman believed that all intellectual abilities could be seen as a function of two factors which he defined as a 'general' or intellectual factor that is common to every ability, and a 'specific' factor which is specific to a particular ability and is different from all others. The idea of a general factor is further supported by the fact that when a large number of intelligence tests are given, those who achieve high scores on one test tend to achieve high scores on all tests. The same is true for those with low and average scores.

Even though the above is true, there is still variance among the tests that cannot be accounted for. This is due to the fact that intelligence cannot be separated from the rest of personality. As Wechsler has stated, intelligent behavior must involve something more than sheer intellectual ability. He recognized that although intelligent behavior may utilize the traits or abilities specified, it is also dependent upon the nonintellective factors and the capacity of the individual to apprehend and respond to values of a moral, esthetic, and social nature (Matarazzo, 1972).

Keeping in mind that intelligence is not merely a sum of intellectual abilities, we can still only attempt to evaluate it through the measurement of the different aspects of these abilities.

Nature of the Study

> "The practical tests of today differ from the tests of 1920 as today's automobiles differ from those of the same period: more efficient and more elegant, but operating on the same principles as before" (Cronbach, 1960, p. 159).

The men to have had the most profound impact on the research in intelligence had developed their most important concepts by 1905. Francis Galton, studying individual differences, had generated a large-scale testing program in 1882; Charles Spearman had outlined his theory of general intelligence in 1904; and in 1905 Binet and Simon developed the first useful test of intelligence. Since that time many tests designed to measure intelligence have been developed. The purpose of this study was to examine three of these measures of intelligence to determine the relationships among them. These measures were; the Wechsler Adult Intelligence Scale-Revised (WAIS-R), the Standard Progressive Matrices (SPM), and the Shipley-Institute of Living Scale (SILS).

Spearman considered the Standard Progressive Matrices as perhaps the best of all nonverbal tests of the general factor of intelligence (*g*) (Burke, 1958). Vernon referred to it as "one of the purest tests of *g* available" (Vernon, 1947). Raven himself, though, has stated that by itself "it

is not a test of 'general intelligence'" (Raven, 1948, p. 13). Other authors (Sattler, 1982; Hunt, 1974) have challenged the notion that the Progressive Matrices measures one general ability by professing that the Progressive Matrices can be solved through more than one approach. The two approaches identified are a verbal analytic approach and a visual perceptual approach. One intent of the study was to examine the relationship between the Standard Progressive Matrices and the WAIS-R subtests to explore what abilities the SPM is related to, and to determine if indeed the SPM is a pure measure of *g* as indicated by Spearman and Vernon. As well, both the Shipley-Institute of Living Scale and the Standard Progressive Matrices have been used in clinical settings as quick estimates of Full Scale WAIS IQ's. Another intent of this study then, was to determine how well these estimates approximate the actual WAIS-R IQ.

Description of the Instruments

Wechsler Adult Intelligence Scale-Revised - the WAIS-R is the most recent edition of Wechsler's Adult Intelligence Scales that began with the Wechsler-Bellevue in 1939. The goal of the Wechsler-Bellevue was to provide an intelligence test that was suitable to use with adults. Today the WAIS-R is one of the most frequently used individual psychological tests and is one of the major tests of intelligence. The

WAIS-R consists of six verbal subtests and five nonverbal subtests from which a Verbal IQ, a Performance IQ, and a Full-Scale IQ can be obtained. As the procedures for administering and scoring the WAIS-R involve a lot of time expenditure, attempts have been made to provide brief alternatives to this test. Two tests that are used as alternatives are the Raven's Standard Progressive Matrices and the Shipley-Institute of Living Scale.

Standard Progressive Matrices - the SPM is a nonverbal test of reasoning ability. It consists of 60 perceptually based tests that can be broken into 5 subsets measuring different abilities. According to Raven, Court & Raven (1977), the test assesses a person's capacity to form comparisons and reason by analogy. It compares people with respect to their immediate capacity for observation and clear thinking. This test is considered culture-reduced, therefore it has been deemed valuable for clients whose first language is not English.

Shipley-Institute of Living Scale - the SILS has rather wide usage in educational and instituational settings. Also called the Shipley Hartford Scale, it was designed to provide a quick self-administered measure of mental deterioration. Over the years it has been deemed more useful in clinical settings as a brief measure for estimating current intellectual ability. This test consists

of two subtests, one measuring vocabulary and one measuring abstract reasoning.

Research Questions

The following research questions formed the basis of the study:

1. Is the relationship between the WAIS-R subtests and the Standard Progressive Matrices the same for all individuals?
2. Does the Shipley-Institute of Living Scale give an accurate estimate of WAIS-R Full Scale IQs?
3. Does the Standard Progressive Matrices give an accurate estimate of WAIS-R Full Scale IQs?

Design of the Study

The Wechsler Adult Intelligence Scale-Revised, the Standard Progressive Matrices, and the Shipley-Institute of Living Scale were administered in a random order to 47 Community College volunteers and to 47 clients who had been referred, or referred themselves, to the Education Clinic at the University of Alberta for intellectual assessment. The examiners were 19 graduate students completing a practicum component of a course in psychological testing at the University of Alberta. Multivariate and univariate statistical techniques were used to answer the research questions.

Limitations of the Study

1. The majority of the sample volunteered to be tested, making the study subject to the limitations of volunteer research (Rosenthal & Rosnow, 1975).
2. For the factor analytic techniques, the sample size was not as large as is normally recommended when using this type of statistical technique. Therefore, the results from these analyses must be viewed tentatively.
3. The use of more than one experimenter may account for some of the individual differences in the administration and scoring of responses on the WAIS-R.

Overview of the Study

In chapter I, the three intellectual measures used in this study were introduced and the purpose of this study was presented. Chapter II provides a review of the related literature. In chapter III the design of the study is outlined, including the details of client selection, a description of data collection, and techniques of analyses. Chapter IV contains an analysis of the data obtained, and chapter V is a discussion of the results, conclusions drawn, and implications for further research.

CHAPTER II

RELATED LITERATURE

"Intelligence, as a hypothetical construct . . ." (Matarazzo, 1972, p.79). Unfortunately, in its everyday usage, the term "intelligence" is often employed without the qualifer - a hypothetical construct. This is not to say that the term "intelligence" should not be utilized, as it is useful for explaining behavior. Though, according to Shibles (1971), "When the metaphor is created to give insight to a concept, we have a clear case of language preceding thought and at the same time of language constituting reality" (p. 82). The problem then arises, as commented on by Bruer, of it being "only too easy to fall into a habit of thought that which assumes that every substantive has a substance behind it . . . we find as time goes on that we have actually formed an idea which has lost its metaphorical nature and which we can manipulate easily as though it were real. Our mythology is then complete" (Cited in Sarbin & Coe, 1972, p. 52). The concept of intelligence can be viewed in the same light, as its hypothetical nature sometimes becomes obscured and it becomes easy to discuss the concept as if it were an actual structure that existed. "The historical origin of the term has been partly responsible for man's dissension and

misunderstanding. They have led us to reify intelligence as some kind of thing or monolithic entity in the mind" (Vernon, 1979, p.39).

Brief Overview of Theories of Intelligence

Alfred Binet.

Binet has been regarded as the father of intelligence testing (Sattler, 1982). He was convinced that intelligence was embedded within the total personality of a person, so he viewed intelligence as a component of all acts of behavior, where intelligence was an attribute of the behavior, not an attribute of the person. Binet believed that a number of faculties, such as judgment, practical sense, initiative, and the ability to adapt oneself to circumstances, were essential to intelligence. Therefore, his 1905 scale was developed to sample a wide range of these functions. "Regarding intelligence as a product of many abilities, Binet sought in his tests to measure not an entity or a single dimension - 'general intelligence' - but rather an average level - 'intelligence in general'" (Tuddenham, 1962, p. 49).

Charles Spearman.

Spearman was one of the first theorists to use factor analysis to explain intelligence. From his research he postulated the theory that any intellectual activity

involved a general factor (*g*), which is common to all kinds of mental activity, and a specific factor (*s*), which it shares with none. He believed *g* to be possessd by everyone to varying degrees, and it was considered to be the most important aspect of intelligence measured by intelligence tests. Therefore, he felt that an ideal intelligence test would have a very high loading on the *g* factor.

Spearman refused to identify *g* with intelligence, as he considered the term "intelligence" to be vague. He suggested that *g* depended on the general mental energy with which each individual is endowed and that the *s* factor could be activated by this energy (Vernon 1950). *S*-factors were seen to be largely affected by education and training while *g* was innate and ineducable. Spearman described *g* in terms of, "the capacity to educe correlates and relations" (Brody & Brody, 1976, p. 22). Eduction of relations is described as determining the relationship between two or more ideas, while eduction of correlates is finding a second idea associated with a previously stated one.

The chief criticism of Spearman's theory is that he failed to sufficiently allow for types of abilities that are less general than *g*, but are definitely not specific (Vernon, 1961).

E.L. Thorndike.

Thorndike rejected Spearman's evidence for a common *g*. Instead, he postulated that intelligence was composed of a large number of specific elements or factors. These factors could have elements in common with other factors, and could combine to form clusters of general intelligence. He identified three such intelligence clusters:

1. Social - dealing with people.
2. Concrete - dealing with things.
3. Abstract - dealing with verbal and mathematical symbols.

Thorndike viewed intelligence as the total number of connections in the mind which could be innate, acquired, or a combination of both. His view has come to be known as a multi-factor theory of intelligence.

Thurstone.

Thurstone was concerned with discovering primary abilites, and describing individual differences in ability in terms of an individual's scores on a set of primary ability factors. His was a 'group-factor theory' and he discounted the *g* factor by saying that independent factors were crucial to the structure of intelligence. He labelled six primary abilities as Verbal, Number, Spatial, Word Fluency, Memory, and Reasoning. Any complex intellectual performance was believed to be based on a mixture of these, and intelligence would be analyzable into these primary

abilities, all of which had equal weight.

Thurstone, then, assumed that performance on a test of abilites was dependent on a certain number of primary abilities or group factors. He also assumed that the number of group factors would be less than the number of tests administered, and that performance on a particular test did not necessarily involve all the primary abilities that were used to explain the performance on all the other tests.

Even though Thurstone initially eliminated *g* as a significant component of mental functioning, he later found that the primary factors were related to one another. He then argued that *g* would emerge as a second-order factor but that it was not the only second-order factor that would emerge.

J.P. Guilford.

Guilford is well known for his Structure of Intellect model (S-O-I), which is based on the notion that there are three dimensions whose combinations determine different types of intellectual abilities. Each ability is defined by its unique position on each of the three dimensions. These dimensions are:

1. Material or content - verbal, figural, symbolic, behavioral.
2. Operations - cognition, memory, divergent thinking, convergent thinking, evaluation.

3. By-products - units, classes, relations, systems, transformations, implications.

Intellectual activity can be understood by the kind of mental operation performed, the type of content on which the mental operation is performed, and the resulting product. This model then, implies the existence of 120 different intellectual factors. Guilford did not accept the notion that *g* can be derived as a higher-order factor as he argued that intelligence is too rich and variegated to be adequately defined by a single *g* score or IQ score. This theory then, is a radical departure from the Spearman-Thurstone tradition.

Guilford insisted that the factors discovered in the S-O-I model are found with orthogonal rotation and hence are independent of one another. One problem with this concept is that diverse measures of intellectual abilities do correlate with each other. "We can conclude that Guilford has not really demonstrated that broad general ability factors do not exist, nor indeed has he proven wrong the notion that there exists one pervasive ability factor that enters into a great variety (if not all) intellectual performance" (Brody & Brody, 1976, p. 46).

P.E. Vernon.

Vernon believed that the best way to explain the results of factor analysis was with a hierarchical model. In his hierarchical theory of intelligence, he postulated that a general group factor (*g*) must be considered in an attempt to understand intelligence. Therefore he placed *g* at the highest level of the hierarchy. On the next level he placed two major group factors labelled "v:ed", which represents skill in the Verbal-Educational area, and "k:m", which represents skill in the Spatial-Mechanical field. At lower levels are smaller subdivisions of the two major group factors, called minor group factors. Other more specialized skills (specific factors), peculiar to certain tests, emerge at the next level. Factors low in the hierarchy refer to narrow ranges of behavior, while factors high in the hierarchy refer to a wide range of behaviors.

For Vernon, intelligence corresponds to the general level of complexity and flexibility of a person's "schemata", which are cummulatively built up in the course of a person's lifetime. He believed that a person's innate potential limits their ability to acquire schemata, but that a person can increase the complexity and flexibility of schemata if the environment is stimulating. As these schemata are built, the earlier ones will be more specific, while the later ones that develop will be of higher order

and will contain more of the *g* factor. He also maintained that adults become very specialized, therefore *g* is not a good measure of abilities in later life (Robb, Bernardoni & Johnson, 1972).

David Wechsler.

Wechsler explained that "Intelligence, as a hypothetical construct, is the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment" (Matarazzo, 1972, p. 79). Wechsler's definition implies that intelligence is composed of elements or abilities which are qualitatively different. From his perspective, intelligent behavior results as a function of the way in which these abilites are combined, not just the mere product of the abilites. Therefore, a given excess of any ability may add relatively little to the effectiveness of the ability as a whole. Wechsler also viewed intelligence as being affected by what he referred to as 'connative factors' such as drive and incentive.

Since Wechsler considered intelligence to be a part of the whole layer of personality itself, his search for subtests in designing the Wechsler-Bellevue Intelligence Scale-Form 1 was influenced by his focus on the global nature of intelligence. He did not believe that intelligence tests should have high loadings on *g*, as he

felt that non-intellectual factors, as well as specific factors, were essential in the measurement of intelligence because effective behavior is frequently based on these.

Raymond Cattell.

Cattell's theory can be viewed as a contempory synthesis of the traditions of Spearman and Thurstone. He believed in the importance of *g* and in deriving *g* as a second-order factor. His theory was not directed towards the discovery and description of primary abilities. Instead it was directed towards using tests that loaded on various primary abilities as a basis for second-order factor analysis, thus permitting the description of individual differences in ability at a more abstract and general level.

Cattell postulated that the prominent general factor obtained from correlations among tests of ability consists of two components, crystallized intelligence (Gc) and fluid intelligence (Gf). Crystallized intelligence was seen as consisting of the strategies, skills, and concepts a person has acquired from the cultural environment and educational system, while fluid intelligence was viewed as the biological component that enables a person to solve new problems and grasp new relationships. Fluid intelligence does not correspond exactly to genetically determined ability as such, but represents biological capacity which is dependent upon the influence of the biological environment

with respect to variables such as prenatal influences and nutrition, as well as genetic endowment.

Gc is dependent to a degree upon Gf, as it is only through the exercise of fluid intelligence that crystallized intelligence develops. "The acquisition of intellectual skills as a result of acculturation is dependent not only on the quality of one's cultural and educational experiences but also on the level of fluid ability an individual has which permits him to benefit from the educational experiences made available to him" (Brody & Brody, 1976, p. 75).

The growth curves of Gc and Gf differ, as crystallized intelligence is said to increase with a person's experience and education, while fluid ability is said to develop until approximately age fourteen, and after age 20 begin a gradual decline. Cattell claims that conventional verbal tests measure Gc, while reasoning tests based on abstract shapes primarily measure Gf.

Cattell has challenged the unitary concept of *g* by saying that, "no matter how many such independent abilities are eventually revealed they will be shown to reflect either of two broad group factors - one largely inherited, the other largely learned and both will be found to be heavily correlated with temperament, personality, and motivational characteristics of the individual" (Matarazzo, 1972, p. 58).

J. Piaget.

Piaget viewed intelligence as a form of biological adaptation between the individual and the environment. Behavior becomes more intelligent as the interaction between the individual and the environment becomes more complex. In each experience the interplay between physiological and psychological processess lead the child to develop schemes. Schemes are organized patterns of behavior; ways of organizing, structuring, and interacting with the environment which produce changes in cognitive development. Cognitive processes emerge, then, through a process of development resulting from organism-environmental interactions represented by a reorganization of psychological structures. Mental growth is viewed by Piaget as the formation of new mental structures and the emergence of new mental abilities.

There are two characteristics of intellectual functions - organization and adaptation. Organization is a system underlying a person's acts that is motivated to maintaining a state of equilibrium in the individual. It is through this process of attempting to maintain equilibrium that the organism developes schemes. Adaptation is composed of two components - assimilation and accommodation. Assimilaton involves changing the characteristics of the environment so that they can be incorporated into the structure of the

individual, while accommodation involves restructuring the individual to accommodate the object.

Piaget believed that a person has two types of heredities - specific and general. Specific heredity is composed of the biological structures such as a person's sensory system that limits what a person perceives. General heredity is the inheritance of a "mode of intellectual functioning" that amounts to the manner of dealing with our environment. Specific heredity is not as important as general heredity, as a person's "mode of intellectual functioning" can overcome limitations acquired through specific heredity.

<u>Emerging Trend</u>.

"One result that appears to be emerging is that neither Spearman nor Thorndike were correct in their conception of intelligence. More likely, neither g nor s will survive and both will be replaced by a conception of intelligence such as that of Binet and also Piaget, which postulates different intellectual processess at different stages of human intellectual and behavioral development" (Matarazzo, 1972, p.54).

Three Measures of Intelligence

The Wechsler Adult Intelligence Scales.

"The Wechsler scales remain the unchallanged leaders for evaluating intelligence in individual testing" (Guertin *et al.*, 1971, p. 290). Over the years the Wechsler scales have been submitted to factor analytic procedures in an effort to provide a more concise understanding of what is being measured by these tests. Cohen (1952, 1957a, 1957b) describes the factor structure for both the Wechsler-Bellevue and the Wechsler Adult Intelligence Scale (WAIS). Five factors have been consistently found, three major ones and two minor ones. These are:

1. Factor A - Verbal Comprehension - described as vocabulary richness and verbal-symbolic manipulative ability with loadings from the Information, Comprehension, Similarities, and Vocabulary subtests.
2. Factor B - Perceptual Organization - described as the organization of nonverbal, visually perceived material within the constraint of a time limit. The subtests Block Design and Object Assembly have the strongest loading on this factor, with Picture Arrangement having barely acceptable loadings for all age groups except for the 45 - 54 year olds.
3. Factor C - Memory - previously called Freedom from Distractibility (Cohen, 1952), this factor is described

as involving both immediate memory as well as the efficiency with which previously learned material can be called up when needed. Arithmetic and Digit Span load on this factor.

Picture Completion alone loads on Factor D and Digit Symbol alone on Factor E.

Following a second-order analysis, Cohen concluded that the WAIS Full Scale IQ was very strongly loaded with *g* for adults. "Within the framework of contemporary hierarchical theory, g is implicitly defined as the pervasive overlap among diverse intelligence assessors" (Wallbrown, Blaha & Wherry, 1974, p. 50). Vocabulary and Information were found to be the best measures of *g* over most of the age ranges, while Object Assembly and Digit Span were the poorest.

Wallbrown, Blaha & Wherry (1974) examined the hierarchical factor structure of the WAIS and found an arrangement of abilities congruent with Vernon's (1950) model consisting of a strong *g* factor and two major group factors v:ed and k:m. The verbal subtests defined v:ed, and the performance subtests defined k:m. Consistent with Cohen's findings, Vocabulary and Information were the best overall measures of *g*, while Digit Span and Object Assembly were the poorest.

Similar analyses have recently been performed on the standardization sample for the Wechsler Adult Intelligence

Scale-Revised (WAIS-R). Silverstein (1982) found the familiar Verbal Comprehension and Perceptual Organization factors described by Cohen but did not consistently find a third factor. He therefore adopted the two-factor solution and concluded that his findings justified the interpretation of the Verbal and Performance IQs.

Blaha and Wallbrown (1982) examined the hierarchical factor structure of the WAIS-R, and consistent with Cohen's findings for the WAIS, interpreted a strong *g* factor defined by loadings on all eleven subtests. As well, they labeled a major group factor corresponding to the v:ed dimension and defined by Vocabulary, Information, Comprehension, Similarities, and to a lesser degree Arithmetic and Digit Span; and a minor group factor corresponding to k and defined by Block Design and Object Assembly. The k factor for the WAIS-R was not as coherent and distinct as the k:m factor of the WAIS, though the authors concluded that the overall positive loadings of the Performance subtests were sufficient to justify using the Performance IQ as a crude indicator of k.

Standard Progressive Matrices (SPM).

The Raven's Progressive Matrices test was originally designed by Raven to measure Spearman's *g*. Some researchers have considered it to be among the best measures of *g* (Vernon, 1947; Orme, 1966). Raven, Court & Raven (1977) described the Standard Progressive Matrices (SPM) as, "a test of a person's capacity at the time of the test to apprehend meaningless figures presented for his observation, see the relations between them, conceive the nature of the figure completing each system of relations presented, and, by so doing, develop a systematic method of reasoning" (p. SPM2). This definition encompassess Spearman's concepts of eduction of relations and eduction of correlates which he used to define *g*. Raven (1948) though, states that the Progressive Matrices "is not a test of general intelligence and it is always a mistake to describe it as such" (p. 13).

While various investigators have stated that the Progressive Matrices is a measure of *g*, others have concluded that, "there is relatively little foundation for asserting that Ravens is a better measure of g than other or different kinds of tests" (Brody & Brody, 1976, p. 181). Bortner (1965) indicated that rather than providing a measure of intellectual capacity, the Progressive Matrices seem to be measuring perceptual adequacy. After reviewing

the literature on the Progressive Matrices, Burke (1958) also concluded that there is not enough evidence to indicate that the Progressive Matrices have validity as a pure measure of *g*. One of the major criticisms of the Progressive Matrices is that it is an attempt to measure general intelligence through one modality of performance (Sattler, 1982; Wechsler, 1949).

Suggestions have been made that different people may solve the items of the Progressive Matrices by different methods. Sattler (1982), in his description of the Progressive Matrices, indicated that a method for solving an item can be formulated in verbal terms, or from a visual-perceptual approach. In a similar vein, Vernon (1950) indicated that some people would use visual imagery (a Gestalt-like approach) to solve the problems, while others would use logical, verbal analysis (analytic approach). When Vernon factor analysed test items on the Progressive Matrices, he found that a verbal approach intervened into the most difficult items while a perceptual approach was used for the easier items.

Hunt (1974), in a theoretical analysis, examined systematically two approaches to solving the Advanced Progressive Matrices, and concluded that;

> "There are two ways to solve Raven's Progressive Matrix problems, utilizing quite dissimilar

> psychological techniques. It is particularily interesting that similar scores and similar patterns of correct and incorrect answers would be achieved on Set I by either the Gestalt or (reduced) analytic algorithmns. This observation casts some doubt on the interpretation of a Raven Progressive Matrix Test score as a measure of g, since nothing in the psychometric literature leads one to believe that identical general factor scores should be associated with qualitatively different styles of cognition" (p. 150).

If people do indeed use different approaches to solving the Progressive Matrices, this could account for some of the inconsistencies in the research findings that are discussed later in this chapter.

<u>Shipley-Institute of Living Scale (SILS)</u>.

The Shipley-Institute of Living Scale was originally devised by Shipley (1940) to measure the deterioration of intellectual functioning resulting from mental illness. The scale was based upon the tendency for a discrepancy to appear between vocabulary level and ability to think in abstract when there is an intellectual impairment, as vocabulary is usually least affected but the capacity for conceptual thinking is among those abilities which decline rapidly. Intellectual impairment is expressed by a

"Conceptual Quotient" or C.Q. which is based on the difference between the Vocabulary scale and the Abstract Reasoning score. Subsequent evaluation though, has indicated limited utility of the SILS as a measure of deterioration. Margaret Ives (1953) concluded after reviewing the SILS that:

> "The Shipley scale provides valuable information regarding impairment in abstract thinking when restricted to the select group for which it is suited - above average intelligence, reasonably well-educated with no language handicap, test-sophisticated, not too disturbed to be cooperative, and preferably young" (p. 96).

As the usefulness of the SILS as a measure of intellectual deterioration has been challenged, several investigators (Sines, 1958; Watson & Klett, 1968; Pauker, 1975) have been interested in evaluating its worth as a measure of a person's level of intelligence. As a result, the SILS has gained rather wide usage in educational and institutional settings as a quick substitute for more lengthy intelligence tests (Martin, Blair & Vickers, 1979).

<u>Relationship between the WAIS and SPM</u>

Since the WAIS-R has only been in use for a few years, research has not yet been published that has examined the SPM within the context of this test. A number of studies

have examined the relationship between the SPM and the WAIS with the focus being on how well the SPM predicts WAIS IQs. Some researchers (Vincent & Cox, 1974; Bingham, Burke & Murray, 1966; McLeod & Rubin, 1962; Shaw, 1967) have concluded that the SPM is an adequate substitute for the WAIS, while others (Watson & Klett, 1974; Jurjevich, 1967) have come to the opposite conclusion.

It appears though, that most of the studies have determined that the SPM is an adequate substitute soley on the basis of the correlation coefficient between the WAIS and the SPM. As a correlaton coefficient does not provide information as to the error of estimate between the IQ equivalents and the WAIS IQs, more information is required before such a judgement can be made.

Bingham, Burke and Murray (1966) tested 30 patients referred for vocational counselling at a VA hospital, and found correlations of .80, .79, and .85 with the Verbal, Performance, and Full Scale scaled scores of the WAIS. They concluded that the SPM was a measure of general intellectual functioning. They did not find results to support the hypothesis that the SPM was more highly related to Cohen's Perceptual Organization factor than to his Verbal Comprehension and Memory factors.

Shaw (1967) reported a correlation of .83 with the SPM and WAIS Full Scale IQ for 83 neuropsychiatric patients and

concluded that "the results of the present study indicate it (SPM) can be considered a valuable and economical substitute for the WAIS when only an IQ estimate is required" (p. 185). Orme (1968) criticized Shaw's conclusions by stating that the SPM gives a very useful measure of non-verbal intelligence but from Shaw's statement "it could be argued that the Matrices, being a relatively "pure" measure, is preferable to the omnibus type of measure such as the Wechsler, with its rather short subtests" (p. 95).

Watson & Klett (1974) examined the validity of four nonverbal intelligence tests including the SPM to estimate WAIS IQs for 120 psychiatric patients. They found correlations of .49, .58, and .58 with the SPM and the WAIS Verbal, Performance, and FSIQs and concluded that the correlations were not high enough to recommend its use as a substitute for the WAIS. Also resulting from this study was the finding that the Performance section of the WAIS was a better estimate of intelligence, using the Verbal IQ as the criterion, then any of the four tests examined.

Jurjevich (1967) investigated the validity of approximating WAIS Full Scale IQs from the SPM for 131 military MP clinic outpatients and he too concluded that the substitution of the SPM for the WAIS was not warranted. He also found that the SPM was more closely associated with the weighted scores on the Similarities subtest than on the

Block Design subtest of the WAIS.

Burke & Bingham (1969) factor-analysed the SPM with Cohen's factors from the WAIS. The subjects were 91 male patients from a VA hospitial referred for vocational counselling. The correlations between the SPM and the WAIS Verbal, Performance, and Full Scale IQs were .65, .76, and .75. For the intercorrelations between the SPM and the WAIS subtests, the highest correlations were with Picture Completion (.64), Object Assembly (.62), and Block Design (.60), while the lowest correlations were with Arithmetic (.43) and Digit Span (.47). When the intercorrelations were submitted to a principal components analysis, all variables, except age, loaded on a single factor of intellectual functioning. A varimax rotation was performed from which the authors extracted five factors. The results indicated that the SPM was positively related to a general factor of intellectual functioning that was highly verbal, only minimally related to a perceptual organization factor, and unrelated to speed and memory factors. The extraction of five factors, when only eight variable were included in the analysis, is questionable due to Guilford's (1952) suggestion that there should be three times as many variables as expected factors.

<u>Relationship between the WAIS and the SILS</u>

Numerous studies (Sines, 1958; Sines & Simmons, 1959; Paulson & Lin, 1970; Wiens & Banaka, 1960; Stone & Ramer, 1965; Watson & Klett, 1968; Bartz, 1968) have investigated the relationship between the SILS and the WAIS with reported correlations ranging from .73 to .90. Most of the studies concluded that the SILS could be a valuable tool for predicting WAIS IQs if used cautiously. Though, most of these judgments are based soley on the strength of the correlation coefficient between the SILS and the WAIS.

Wiens & Banaka (1960) found a correlation between the Shipley total score and WAIS FSIQ of .80 for 140 psychiatric patients and concluded that the Shipley may be used in a hospital setting as a substitute of the WAIS. Watson & Klett (1968) found correlations between the Shipley and the Verbal, Performance and Full Scale IQs of the WAIS of .74, .59, and .78. Scatterplots indicated that the relationship between the Shipley and WAIS deteriorated at the lower and low-middle IQ ranges and they concluded that the Shipley corrected scores were useful predictors of WAIS IQ only for people of average or above intelligence.

Bartz (1968), for 91 patients, obtained correlations of .66, .65, and .73 between the WAIS Full Scale IQ and Shipley Verbal, Abstraction and Total score. Stone & Ramer (1965) concluded from a study on 51 psychiatric patients that "The

Shipley Scale appears to be valuable as an economical substitute for the WAIS when only an IQ estimate is required" (p. 297).

Several investigators (Bartz & Loy, 1970; Paulson & lin, 1970; Sines & Simmons, 1959) have provided tables to convert total raw scores on the Shipley scale into WAIS IQ equivalents. Dennis (1973) compared the efficacy of several such conversion tables for 37 psychiatric outpatients and concluded that "Paulson & Lin's age corrected table lead to the best prediction as indicated by the highest correlation with actual FSIQ (.79) and the smallest standard error of estimate (7.7). Additionally it was discovered that the age-scaled table worked equally well at higher and lower SH levels" (P. 367).

Pauker (1975) found sex differences in predicting WAIS IQs using Paulson & Lin's tables where women's predicted IQs tended to be higher than the WAIS IQs, and men's predicted IQs tended to be lower than the actual WAIS IQs. He also found that the predicted IQs and actual IQs differed by ten or more IQ points in 15% of the males and 23% of the females.

Black (1974) examined the utility of using the Shipley as a predictor of WAIS FSIQ for 40 patients with traumatic head injuries. He found that all predicted IQs were higher than the actual WAIS Full Scale IQs, but concluded that the

mean predicted IQ using the Paulson and Lin tables were not significantly different from mean WAIS Full Scale IQs. A correlation of .70 was reported between the predicted IQs and the WAIS IQ.

Conclusion

In summary, over the past century several theories have been advanced to explain the hypothetical construct of "intelligence". Along with the theories, several tests have been developed to evaluate intelligence in individuals. One such test, the Standard Progressive Matrices, was originally designed to measure Spearman's *g*. There is some controversy though, over what in fact the Progressive Matrices does measure, with some researchers suggesting that it can measure different abilities in different people. Before this test can be effectively utilized as an intelligence measure, further research will be necessary to establish what abilities are required to solve the SPM, and whether these abilities are the same for all people.

As well, brief intelligence tests are frequently used as replacements for some of the more comprehensive tests such as the Wechsler Adult Intelligence Scale-Revised. This is for practical reasons, as the brief tests involve less time and expense, and are also less of a burden on the examinee.

Results from studies examining the validity of using the Standard Progressive Matrices as a substitute for the WAIS have been inconsistent, possibly due to the fact that individuals may use different abilities to solve the Progressive Matrices items.

More consistent findings have been reported from studies examining the validity of predicting WAIS IQs from the Shipley Institute of Living Scale. With the recent revision of the WAIS though, further research must be conducted to determine if the Shipley Institute of Living Scale can be used as a valid predictor of WAIS-R IQs.

CHAPTER III

DESIGN AND PROCEDURES

The Sample

The sample[1] consisted of 97 individuals; 47 volunteers from Grant MacEwan Community College in Edmonton, Alberta, and 47 clients who had been referred, or referred themselves, for assessment to the Education Clinic at the University of Alberta.

The Community College sample included 19 males and 28 females ranging in age from 18 years, 4 months, to 44 years, 7 months (mean=24.49; SD= 6.76). For the majority of the students (80.9%), English was their first language. Of those for whom English was not their first language, 55.6% spoke English fluently.

The sample from the Education Clinic included 24 males and 23 females ranging in age from 16 years, 4 months to 58 years, 7 months (Mean = 27.21; S.D. = 7.52). For the majority of the clients (91.5%), English was their first language. Of those for whom English was not their first language, 75% spoke English fluently. The majority of the people had an educational level of 'some post-secondary education' or higher (59.6%). The most frequent occupation reported was 'student' (31.9%), with

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[1]Appendix A reports the distribution of the clients by demographic variables.

'secretarial/semi-skilled' being the next most frequent occupation reported (29.8%). Thirty-four percent of the clinic referrals reported their employment status was full-time employment, and 31.9 percent reported that they were full-time students. In terms of the reason for being referred for assessment, 'academic problems' was the most frequent reason (34.0%).

The Instruments

Wechsler Adult Intelligence Scale-Revised (WAIS-R).

The WAIS-R is the most recent edition of Wechsler's Adult Intelligence scales that began with the Wechsler-Bellevue in 1939. Today the WAIS-R is one of the most frequently used individual psychological tests, and is one of the major tests of intelligence. The WAIS-R is composed of eleven tests; six verbal and five nonverbal. These are:

VERBAL	NONVERBAL
Information	Picture Completion
Digit Span	Picture Arrangement
Vocabulary	Block Design
Arithmetic	Object Assembly
Comprehension	Digit Symbol
Similarities	

The sum of scaled scores on the Verbal subtests convert to a

Verbal IQ, the sum of scaled scores on the Nonverbal subtests convert to a Performance IQ, and the total sum of the scaled scores convert to a Full Scale IQ.

As noted in the previous chapter, the validity of maintaining separate Verbal and Performance IQs has been supported. Also hierarchical solutions have obtained an ability hierarchy consisting of a general intelligence factor (*g*), a major group factor corresponding to the verbal-educational (v:ed) dimension, and a minor group factor corresponding to the spatial-perceptual (k) dimension.

The WAIS-R was standardized on a sample of 1,880 men and women from the United States ranging from 16 to 74 years of age. The sample was matched according to the 1970 United States Census and other populaton reports for age, sex, race (white, non-white), geographic region, occupation, education, and urban-rural residence.

Limitations of the WAIS-R are its lengthy administration time of 60 to 90 minutes, its limited floor and ceiling in that the test does not discriminate among IQs lower than 45 or above 150, and the difficulty of scoring some of the subtests.

Reliability

A split-half procedure to estimate the reliabilites of the WAIS-R test was employed for all of the subtests, exluding Digit Span and Digit Symbol. For Digit Span and Digit Symbol, the reliability coefficients were test-retest coefficients. The reliability for the Verbal, Performance, and Full Scale IQs were calculated by a formula by Guilford (1954, p. 343). Across all nine age groups, the average reliability coefficients for the three IQs were .97, .93, and .97, for the Verbal, Performance, and Full Scale IQs respectively. For the eleven subtests, average reliabilities ranged from .96 for Vocabulary to a low of .68 for Object Assembly. The coefficients for the Verbal subtests were generally higher than the Performance subtests, with Picture Arrangement and Object Assembly only obtaining moderate reliabilities.

Validity

As the WAIS-R has only been released since 1981, there have been few studies to date assessing the validity of the test. One study, reported in the WAIS-R manual, examined the relationship between the WAIS and the WAIS-R. The WAIS-R and the WAIS were administered in counterbalanced order to 72 adults aged 35 to 44 years. The results indicated that for the IQ measures, the WAIS Verbal, Performance, and Full Scale IQs were about 7, 8, and 8

points higher respectively, than were the WAIS-R IQs. Correlations between the IQs were .91, .79, and .88 for the Verbal, Performance, and Full Scale IQs respectively.

Standard Progressive Matrices (SPM).

The SPM consists of 60 visually presented patterns or matrices from each of which a part has been removed. The testee has to examine the matrix and select the missing part from 6 to 8 alternative pieces presented. The 60 tests are comprised of 5 sets of 12 tests. The principles of the sets are based on:

1. Continuous patterns
2. Analogies
3. Development of figures
4. Permutations and alternations of patterns
5. Resolving figures into constituent parts

The five sets begin with easy problems and end with difficult ones. The test was not intended to be used with a time limit.

Originally designed in 1938, a small correction was made to one item in 1947, and in 1956 the problems as well as the alternatives between what choices could be made were rearranged. No other changes have been made to the scale.

Performance on the Raven's Progressive Matrices has been shown to be age related in that performance begins to decline sometime after 20 years of age (Orme, 1966; Guttman,

1981). Orme (1966) calculated "hypothetically true" norms from the published norms for the SPM. These norms were based on the assumption that the increase of ability in childhood, and the decline in adult life, is linear. Peck (1970) obtained percentiles from Orme's norms and transformed these into corresponding IQ equivalents with a mean of 100 and a standard deviation of 15.

Limitations of the SPM are its overestimation of IQ, its restricted ceiling, and its attempt to measure *g* through only one modality.

Reliability

Raven, Court & Raven (1977) indicated that the majority of studies examining consistency, report correlations of at least .90. Burke (1972) using the Spearman-Brown formula, obtained a reliabiliy coefficient of .96 and concluded that the corrected split-half reliability was better than the split-half reliability for WAIS performance scores. Raven, Court & Raven (1977) reported that well-conducted studies indicate satisfactory test-retest reliability for the SPM up to a period of one year with short-term reliability being approximately .90, reducing to approximately .80 at longer intervals.

Validity

Burke (1958) reported that validity coefficients for the SPM range from .23 to .86. Correlations with the WAIS

have ranged from .67 to .88 (McLeod & Rubin, 1962; Pringle & Haanstad, 1971; Shaw, 1967; Burke & Bingham, 1969). However, Raven (1977) reported that "cross-cultural research fails to confirm the magnitude of these findings" (P. SPM7). Vincent & Cox (1974) reported correlations of .70, .38, and .68 with the Otis Gamma, Revised Beta, and Quick Test repectively. McLaurin & Farrar (1973) found a moderate correlation (.45) with the SPM and the Minnesota Paper Form Board, but a low correlation (.21) with 121 college students' grade point averages. Overall correlations with the SPM and concurrent achievement measures tend to be lower than with intelligence tests (Raven, Court & Raven, 1977).

Shipley Institute of Living Scale (SILS).

The SILS was originally designed to provide a quick, self-administered measure of mental deterioration. It has been deemed more useful as a brief measure for estimating current intellectual ability. The SILS consists of a ten minute Vocabulary subtest of forty multiple choice items, and a ten minute Abstract Reasoning subtest of twenty items. Each item on the vocabulary subtest receives one point for each correct response and one point for each four items not attempted within the time limit. The Abstraction subtest receives two points for each correct response. The sum of the two subtests produce a total score.

One limitation of the SILS is that it tends to be a useful predictor of WAIS IQs only for individuals of average or above intelligence (Watson & Klett, 1968).

Reliability

The SILS has shown moderate reliability. Shipley (1940) for 322 army recruits, reported split-half reliabilities of .87, .89, and .97 for the Vocabulary, Abstraction, and Total scores respectively. Test-retest reliabilites for 1 month to 4 months time intervals tend to be lower, ranging from .62 to .82 (Shaw, 1966; Goodman *et al.*, 1974; Martin *et al.*, 1977).

Validity

Reported correlations between the SILS and the WAIS range from .58 to .85 (Shaw, 1967; Watson & Klett, 1974b; Burke & Bingham, 1969). Correlations with the Slosson Intelligence Test have been lower, ranging from .46 to .69 (Martin *et al.*, 1977; Martin *et al.*, 1979b; Martin *et al.*, 1981). The SILS has also been reported to correlate .68 with the California Short-Form Test of Mental Maturity (Martin, et al, 1979b). Martin, et al (1979a) also reported correlations with the Quick Word Test and the Wide Range Vocabulary Test-Form B of .68 and .73 respectively.

Data Collection Procedures

During the period of February 1 to April 30, 1983, the Wechsler Adult Intelligence Scale-Revised, the Standard Progressive Matrices, and the Shipley Institute of Living Scale, were administered in a random order to 94 individuals by 19 graduate students completing a practicum component of a course in psychological testing at the University of Alberta. The majority of the clients completed the tests in one session with the longest period for completion being one week.

The instruments were administered and scored according to the directions provided in the respective manuals. The SPM was given *without a time limit*. Even though the examiners were students, it has been shown that examiner's experience is not of critical importance in improving scoring accuracy on the WAIS-R (Ryan, Prifitera, & Powers, 1983). As well, the WAIS-R protocols were checked over by a certified psychologist in all cases except for the tests administered by the author. Estimated IQs were calculated for the SILS total score from Paulson & Lin's (1970) tables, and estimated IQs were calculated for the SPM total score from Peck's (1970) tables.

Analysis of Data

Three statistical software packages were used for the data analysis. These were the XDER package maintained by the Division of Education Research Services (DERS) at the University of Alberta; the Statistical Package for the Social Sciences (SPSS); and the Biomedical Data Processing package (BMDP). The last two packages are available through Computing Services at the University of Alberta.

A cluster analysis procedure was used to identify profiles of abilities based on the individual's performance on the subtests of the WAIS-R and the SPM. A profile analysis was used to determine if there was an overall significant separation between the clusters. Pearson Product Moment Correlations and factor analytic techniques were used to explore whether the individuals in each of the clusters used different abilities to solve the SPM.

Pearson Product Moment Correlations were calculated to establish the relationships between the WAIS-R, the SILS and the SPM. A oneway analysis of variance with repeated measures was used to determine whether mean differences existed between the WAIS-R Full Scale IQ, and the SILS and SPM estimated IQs. Difference scores were also calculated between the three IQs to determine the range of errors of estimation.

CHAPTER IV

RESULTS

The results of the study are presented in three main sections corresponding to the research questions. The intent of the questions was to examine whether the relationship between the WAIS-R subtests and the Standard Progressive Matrices is the same for all individuals; the Shipley Institute of Living Scale gives an accurate estimate of WAIS-R Full Scale IQs; and the Standard Progressive Matrices gives an accurate estimate of WAIS-R Full Scale IQs.

Question I:

Is the relationship between the WAIS-R subtests and the Standard Progressive Matrices the same for all individuals?

Cluster Analysis.

In order to test the research question, it was first necessary to determine if the individuals in the study performed in a similar manner over all of the tests, or if different patterns of performance could be identified. To do this, the eleven subtests from the WAIS-R and the total score from the SPM, for the 94 individuals, were submitted to a cluster analysis procedure.[2] Three clusters were chosen

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[2] This procedure classifies cases by assigning them to the cluster whose center (mean of the cases in the cluster) is closest to the case.

since, in the four and five cluster solutions one or more cluster contained fewer than 10 individuals. The three cluster solution consisted of 40, 25, and 29 individuals respectively.

Having defined the three clusters, analyses to determine if the clusters were significantly different from each other were performed.

<u>Analyses of Cluster Profiles</u>.

<u>Multivariate Analyses</u>

The twelve variables were rescaled, over the total sample, to a mean of 10 and a standard deviation of 3 in order to bring the SPM score into the same metric unit as the WAIS-R subtests. Table 4.1 provides the means and standard deviations of the variables for each of the clusters separately. The means of the cluster profiles are plotted in Figure 4.1.

A one-way multivariate analysis of variance was conducted to compare the mean differences among the three clusters across the twelve variables. The results indicated that there was a significant separation between the clusters across the variables ($p < .01$). It appears that individuals in Cluster I can be described as having high verbal and high nonverbal abilities; the individuals in Cluster II can be described as having low verbal but high nonverbal abilities; and the individuals in Cluster III can be described as

TABLE 4.1
MEAN SCORES AND STANDARD DEVIATIONS*
WAIS-R SUBTESTS AND STANDARD PROGRESSIVE MATRICES

	Cluster I (n=40)		Cluster II (n=25)		Cluster III (n=29)	
	Mean	SD	Mean	SD	Mean	SD
Inf	11.72	2.64	8.41	2.19	9.00	2.92
DSp	11.63	2.52	8.46	2.60	9.09	2.91
Voc	12.31	2.41	7.71	1.89	8.79	2.21
Ari	11.95	2.51	8.59	2.51	8.53	2.51
Com	12.21	1.97	7.61	1.83	9.01	2.92
Sim	12.26	2.29	7.67	1.66	8.89	2.61
PC	10.95	2.27	11.49	3.02	7.41	2.17
PA	10.93	3.00	10.94	1.95	7.90	2.74
BD	11.53	2.50	11.05	2.11	6.99	1.91
OA	11.42	2.69	10.69	2.55	7.45	2.06
DSy	11.72	2.59	9.96	2.63	7.67	2.19
SPM	11.82	1.45	9.94	1.82	7.55	3.63

*rescaled scores

TABLE 4.2
COMPARISON OF CLUSTER PROFILES

SOURCE	DF1	DF2	F-ratio	Prob.
Oneway MANOVA	24	160	12.61	< 0.01
Parallelism	22	162	4.06	< 0.01

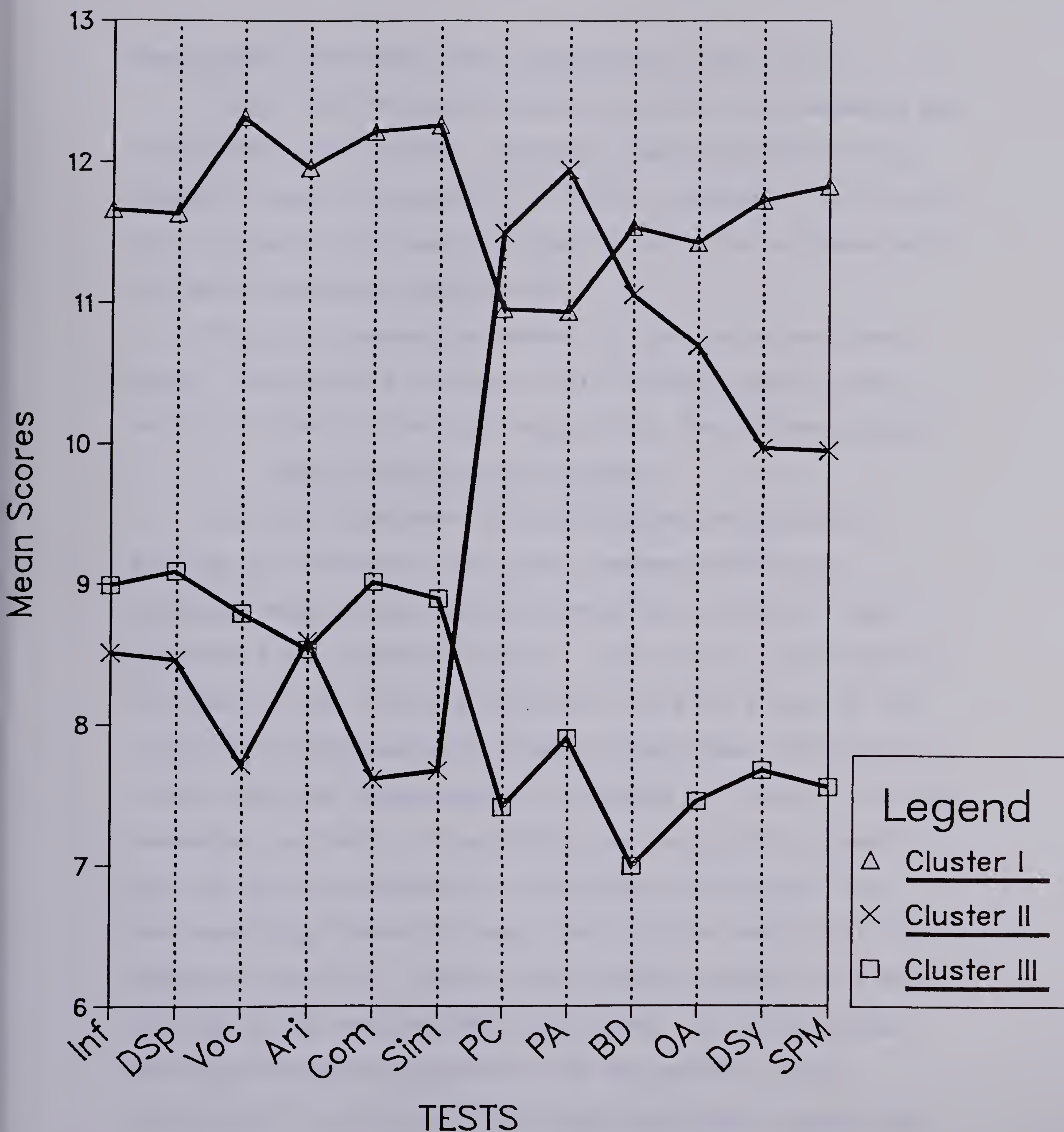

Figure 4.1 CLUSTER PROFILES

having both low verbal and low nonverbal abilities.

A test for the parallelism of profile line segments was calculated. The results indicated that the profile line segments were not parallel ($p < .01$), therefore the clusters do not display the same profiles of abilities as measured by the WAIS-R subtests and the SPM.

Table 4.2 presents a summary of the above mentioned tests. The results of these tests indicate that it was valid to classify the individuals into the defined clusters.

<u>One-way Analysis of Variance</u>

In order to determine actual subtest differences between the clusters, individual one-way analysis of variance were carried out on each of the variables (See Appendix B for summary tables). The results indicated that for each of the Verbal subtests of the WAIS-R and for the Verbal IQ, individuals in Cluster I performed significantly higher than the individuals in Clusters II and III. For the nonverbal subtests of the WAIS-R, excluding Digit Symbol, and for the Performance IQ, individuals in Cluster III performed significantly lower than did the individuals in Clusters I and II. For the Digit Symbol subtest, the WAIS-R Full Scale IQ, and the SPM total score, all three groups were significantly different from one another, with individuals in Cluster I obtaining the highest scores and individuals in Cluster III the lowest scores. To summarize,

the scores on the Verbal subtests were generally similar for Clusters II and III, and the scores on the nonverbal subtests were generally similar for Clusters I and II.

Two-way Analysis of Variance

A two-way analysis of variance with repeated measures on one factor was carried out to determine if there were significant differences between the Verbal and Performance IQs for each of the clusters. Table 4.3 presents a summary of the analysis and Table 4.4 presents the post hoc findings. The results indicate that there were no differences between the Verbal and Performance IQs for Cluster I. For Cluster II, the Performance IQ was significantly higher than the Verbal IQ, and for Cluster III, the Verbal IQ was significantly higher than the Performance IQ.

Analyses of People Within Clusters.

Chi-square Analysis

To determine if other characteristics, besides performance on the tests, defined the people within the clusters, chi-square analyses were calculated on the following variables; sample (Grant MacEwan, Clinic Referral), sex, occupation, education, referral reason, whether English was their first language, and whether English was spoken fluently (See Appendix C for summary tables). There were no significant differences among the

TABLE 4.3
TWO-WAY ANALYSIS OF VARIANCE WITH REPEATED MEASURES
VERBAL VERSUS PERFORMANCE IQ BY CLUSTER

Source	SS	DF	MS	F-ratio	Prob
Cluster	14486.184	2	7243.090	62.869	.001
S-within	10484.000	91	115.209		
IQ	109.320	1	109.320	1.812	.182
Interaction	5537.391	2	2768.695	44.884	.001
BS-within	5491.000	91	60.341		

TABLE 4.4
TUKEY MULTIPLE COMPARISIONS ON THE DIFFERENCE
BETWEEN VERBAL AND PERFORMANCE IQs

SOURCE	VIQ	PIQ	DIFF	Q	PROB
Cluster I	117.65	115.25	2.40	1.95	NS
Cluster II	95.52	112.16	16.64	10.71	**
Cluster III	99.41	89.83	9.58	6.64	**

** significant beyond the .01 level

three clusters for the above variables except for referral reason and occupation. People referred for academic problems tended to be over-represented in Clusters II and III. For occupation, all the professional people were in Cluster I, while the semi-skilled and unskilled people tended to be over-represented in Cluster III.

Pearson Product Moment Correlations

Since it was established that three profiles of abilities could be defined, the next step was to determine the relationship between the WAIS-R subtests and the SPM for the individuals in each cluster. To do this, Pearson Product Moment Correlations were calculated between the SPM and the eleven WAIS-R subtests for each of the three clusters. As the clusters were defined such that there was minimal variance within each cluster, the correlation coefficients were attenuated. Therefore, correlation coefficients with a significance level less than .10 are reported. These results are presented in Table 4.5. For Cluster I, the SPM correlated positively with Arithmetic, Picture Completion, Block Design and the Verbal, Performance, and Full Scale IQs. For Cluster II, the SPM had negative correlations with Information, Vocabulary, and Picture Completion, and a positive correlation with Block Design. For this cluster, the SPM did not correlate with any of the WAIS-R IQs. For Cluster III, the SPM again

TABLE 4.5
SIGNIFICANT CORRELATION COEFFICIENTS BETWEEN
THE SPM AND THE WAIS-R SCORES

WAIS-R	Cluster I	Cluster II	Cluster III
Inf		-.2722*	-.2874*
DSp			
Voc		-.3005*	-.3020*
Ari	.3019**		
Com			
Sim			
PC	.2661**	-.3506**	
PA			
BD	.2550**	.3316*	.4682**
OA			
DSy			.2800*
VIQ	.4072**		
PIQ	.2903*		.3063*
FSIQ	.4125**		

* significant beyond the .10 level
** significant beyond the .05 level

correlated negatively with Information and Vocabulary, and positively with Block Design, Digit Symbol, and the Performance IQ.

Factor Analysis

As there were different patterns of correlations between the clusters, especially between Cluster I and the other two clusters, a Principal Axis factor analysis with an oblique rotation using squared multiple correlations in the diagonals was performed on each of the three clusters in order to examine if the SPM loaded with different subtests.[3] As the number of individuals in each of the clusters was very small, the results of this analysis must be viewed tentatively. Comrey (1978) indicated that factor analytic results based on small samples can be considered as hypotheses to be tested in further investigations.

Three factor solutions were chosen for each of the clusters, as, for Clusters I and II there were three eigenvalues greater than one, and for Cluster III the third eigenvalue was close to one (.92). Table 4.6 reports the factor loadings greater than .4 for each of the clusters.

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[3]An oblique rotation was chosen as the factor structure can be better fitted with oblique axes and the simple structure criteria better satisfied (Kerlinger, 1973; Comrey, 1978). As well, some researchers believe that, "an orthogonal rotation is unrealistic, that actual factors are not usually uncorrelated and that rotations should conform to psychological "reality"" (Kerlinger, 1973, p. 673).

TABLE 4.6
ROTATED FACTOR MATRICES

	Cluster I			Cluster II		
	I	II	III	I	II	III
Inf	.528					.868
DSp					.481	-.404
Voc	.859			.642		
Arith			.517		.756	
Comp	.724			.562	.568	
Sim	.423					
PC			.557			
PA			.509		.599	
BD		.729		-.835		
OA		.705				.548
DSy						
SPM			.438	-.468		

	Cluster III		
	I	II	III
Inf		-.564	
DSp	.520		
Voc		-.676	
Arith	.783		
Comp	.452	-.414	
Sim	.477		
PC			
PA	.487		.654
BD		.568	
OA			.713
DSy			
SPM	.413	.754	

For Cluster I, the first factor resembled Cohen's (1950) Verbal Comprehension factor, and factor II resembled his Perceptual Organizaton factor. On the third factor, the SPM loaded with the Arithmetic, Picture Completion, and Picture Arrangement subtests. This factor could also be labelled a verbal factor, as both the Picture Completion and Picture Arrangement subtests have in factor analytic studies, loaded secondarily on a Verbal Comprehension factor. The results from Silverstein's (1982) factor analytic study of the WAIS-R, indicated that Picture Completion loaded secondarily on the Verbal Comprehension factor (.44), and the Picture Arrangement subtest had equal loadings on both the Verbal Comprehension and Perceptual Organization factors (.45). It appears then, that Picture Completion, Picture Arrangement, and the SPM are, for this cluster, nonverbal tests that involve a verbal component. This is further supported by the results of the correlational analyses, as, Picture Completion and Picture Arrangement correlated significantly ($p<.05$) with the Verbal IQ ($r=.3095$, $r=.4404$ respectively), and the SPM had a higher correlation with the Verbal IQ than with the Performance IQ.

For Cluster II, the first factor could be labelled a Verbal Comprehension versus a visual perceptual factor, as the SPM and the Block Design subtest loaded negatively with the Comprehension and Vocabulary subtests. The second

factor could be labelled a memory and social comprehension factor, with the Digit Span and Arithmetic subtests forming the memory component, and the Comprehension and Picture Arrangement subtests forming the social comprehension component. The subtests that loaded on the third factor did not seem to be closely tied together in terms of measuring similar abilities.

For the third cluster, the SPM loaded on both factors I and II. The factor loadings were contradictory though, as the SPM loaded positively with most of the Verbal subtests on factor I and loaded negatively with most of the Verbal subtests on factor II. Upon examination of the raw data for Cluster III, it was found that six people with Verbal IQs over 110, but with low Performance IQs, had been classified into this cluster. The reason for this was, in the Cluster Analysis procedure, there were not enough people with high verbal skills and low nonverbal skills to form a separate cluster. As Cluster III is best defined by people with both low verbal and low nonverbal abilities, the six people were removed, and the analyses were repeated. Table 4.7 reports the significant correlation coefficients between the SPM and the WAIS-R subtests, and Table 4.8 presents the rotated factor matrix. With the removal of the six cases, the positive loadings of the SPM with the Verbal subtests did not emerge. For factor I, the SPM loaded negatively on a

TABLE 4.7
SIGNIFICANT CORRELATION COEFFICIENTS BETWEEN
THE SPM AND THE WAIS-R SCORES FOR CLUSTER III (N=23)

	Inf	DSP	VOC	ARI	COM	SIM	PC
SPM			-.3387*		-.4470**		
	PA	BD	OA	DSY	VIQ	PIQ	FSIQ
SPM		.3911**		.3814**			

* significant beyond the .10 level
** significant beyond the .05 level

TABLE 4.8
ROTATED FACTOR MATRIX FOR CLUSTER III (N=23)

	Cluster III		
	I	II	III
Inf	.666		
DSp			
Voc	.776		
Arith		.774	
Comp	.916		
Sim			.632
PC			
PA			.517
BD			
OA			.572
DSy		.485	
SPM	-.526	.441	

Verbal Comprehension factor, and for factor II the SPM loaded positively on an immediate memory and sequential processing factor. The subtests that loaded on the third factor require skills relating to reasoning and to the visual perception of meaningful stimuli.

In conclusion, the results of the analyses indicate that it is possible to classify the individuals in the study in terms of three distinct profiles of performance. Those individuals who had well developed verbal and nonverbal abilities seemed to use an approach, to solve the SPM, that involved a verbal component. Those individuals whose nonverbal abilities were better developed than were their verbal skills, seemed to rely more on a perceptual approach to solving the SPM. For those people who were low in both verbal and nonverbal abilities, but whose verbal abilities were better developed, SPM performance seemed to be related to a visual perceptual component, and to immediate memory and sequential processing. For both Clusters II and III, the SPM was negatively related to a Verbal Comprehension factor.

<u>Question II:</u>

Does the Shipley Institute of Living Scale give an accurate estimate of WAIS-R Full Scale IQs?

In order to test whether there were mean differences between the WAIS-R Full Scale IQ (FSIQ) and the SILS

estimated IQ, a one-way analysis of variance with repeated measures was carried out comparing the WAIS-R FSIQ with the SILS estimated IQ and the SPM estimated IQ.[4] Table 4.9 presents a summary of the analysis and Table 4.10 presents the post hoc findings. The results indicated that there is a significant difference between the WAIS-R FSIQ and the SILS estimated IQ of 4.9 IQ points. As well, the standard deviation of the SILS estimated IQ (7.6) was significantly lower ($t=8.57$; $df=91$; $p<.001$) than that of the WAIS-R FSIQ (13.6).

For this sample, a positive correlation was obtained between the SILS total score and the age of the individual ($r=.22$, $p<.02$). As the WAIS-R IQs are dependent upon the age range the person falls into, as well as on their performance, it is more appropriate to correlate the SILS total score with the sum of the WAIS-R subtest scaled scores (Pringle & Haanstad, 1971). Table 4.11 presents the correlaton coefficients for the SILS Vocabulary, Abstraction, Total Score, and estimated IQ, with the sum of the scaled scores for the Verbal subtests (VSS), the sum of the scaled scores for the Performance subtests (PSS), the total sum of the scaled scores (TSS), the Verbal, Performance, and Full Scale IQs of the WAIS-R. It can be

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[4]The relationship between the mean scores for the WAIS-R FSIQ and the SPM estimated IQ will be discussed in the next section

TABLE 4.9
ONEWAY ANALYSIS OF VARIANCE WITH REPEATED MEASURES
BETWEEN THE WAIS-R, SILS, AND SPM IQS*

SOURCE	SS	DF	MS	F	PROB.
Between people	24584	92	267.217		
Within people	13638	186	73.323		
Repeated measures	3926	2	1963.000	37.19	<.001
Residual	9712	184	52.783		

*Based on 93 people

TABLE 4.10
TUKEY MULTIPLE COMPARISIONS ON THE DIFFERENCE
BETWEEN WAIS-R, SILS, AND SPM IQS

SOURCE	MEANS	DIFF.	Q	PROB.
WAIS-R vs SILS	106.591 - 111.495	-4.903	6.508	<.001
WAIS-R vs SPM	106.591 - 115.774	-9.183	12.189	<.001
SPM vs SILS	115.774 - 111.495	4.280	5.681	<.01

TABLE 4.11

CORRELATION COEFFICIENTS BETWEEN THE SHIPLEY INSTITUTE OF LIVING SCALE AND THE WAIS-R

WAIS-R	SILS			
	Vocabulary	Abstraction	Total	Est. IQ
VSS	.7192**	.4364**	.6997**	.6884**
PSS	.1856*	.5952**	.4971**	.4636**
TSS	.5843**	.6012**	.7302**	.7054**
VIQ	.6392**	.4947**	.6920**	.7103**
PIQ	.2238*	.6080**	.5274**	.5073**
FSIQ	.5406**	.6511**	.7379**	.7379**

* significant beyond the .05 level
** significant beyond the .001 level

seen that all of the correlations are positive. The largest correlation obtained (.73) was between the SILS total score and the Full Scale IQ of the WAIS-R. The same correlation coefficient was also obtained between the estimated IQ and the WAIS-R FSIQ. The lowest correlaton was between the SILS Vocabulary score and the sum of the scaled scores for the Performance subtests.

Figure 4.2 contains a scattergram of the WAIS-R Full Scale IQs with the SILS estimated IQs. It appears that the relationship between the two IQs deteriorate somewhat at both the lower and upper IQ ranges and that the SILS reaches a low ceiling. As well, it is evident that there is a tendency for the SILS to overestimate the WAIS-R IQs.

Error scores were calculated between the two IQ scores by subtracting the WAIS-R FSIQ from the SILS IQ. Figure 4.3 contains a histogram of the error scores. The predicted IQs underestimated the FSIQ by 10 or more IQ points in 9.7 percent of the cases, and the predicted IQs overestimated the FSIQs by 10 or more IQ points in 25.8 percent of the cases (Mean=4.9; SD=9.46) This resulted in 35.5 percent of all scores being in error of 10 or greater IQ points.

In order to determine if there was a sex difference in the predicted IQs, the error scores were grouped into three categories. These categories were those scores less than -10 error points; those scores between -10 and +10 error

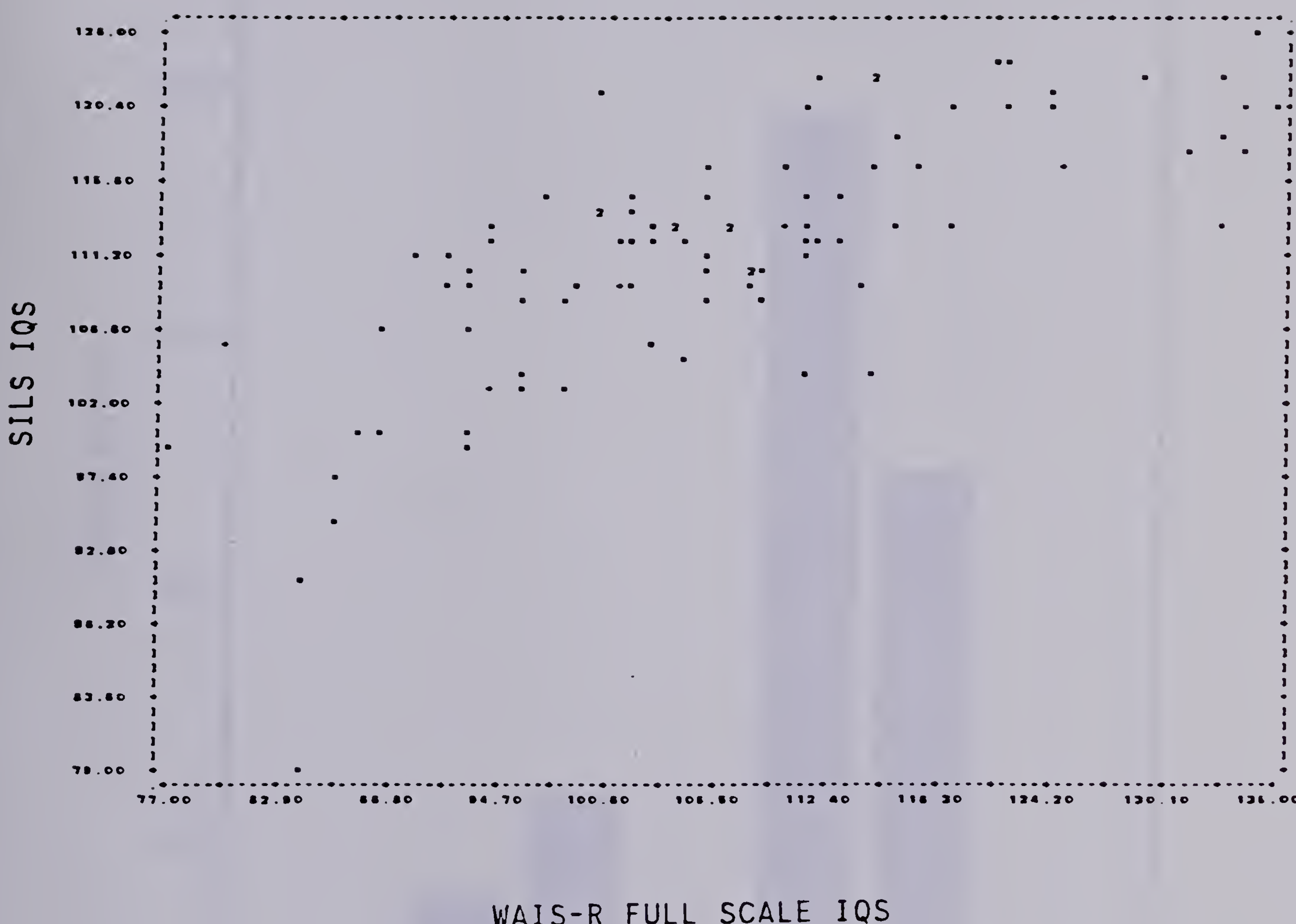

Figure 4.2 SCATTERGRAM OF WAIS-R IQS WITH SILS IQS

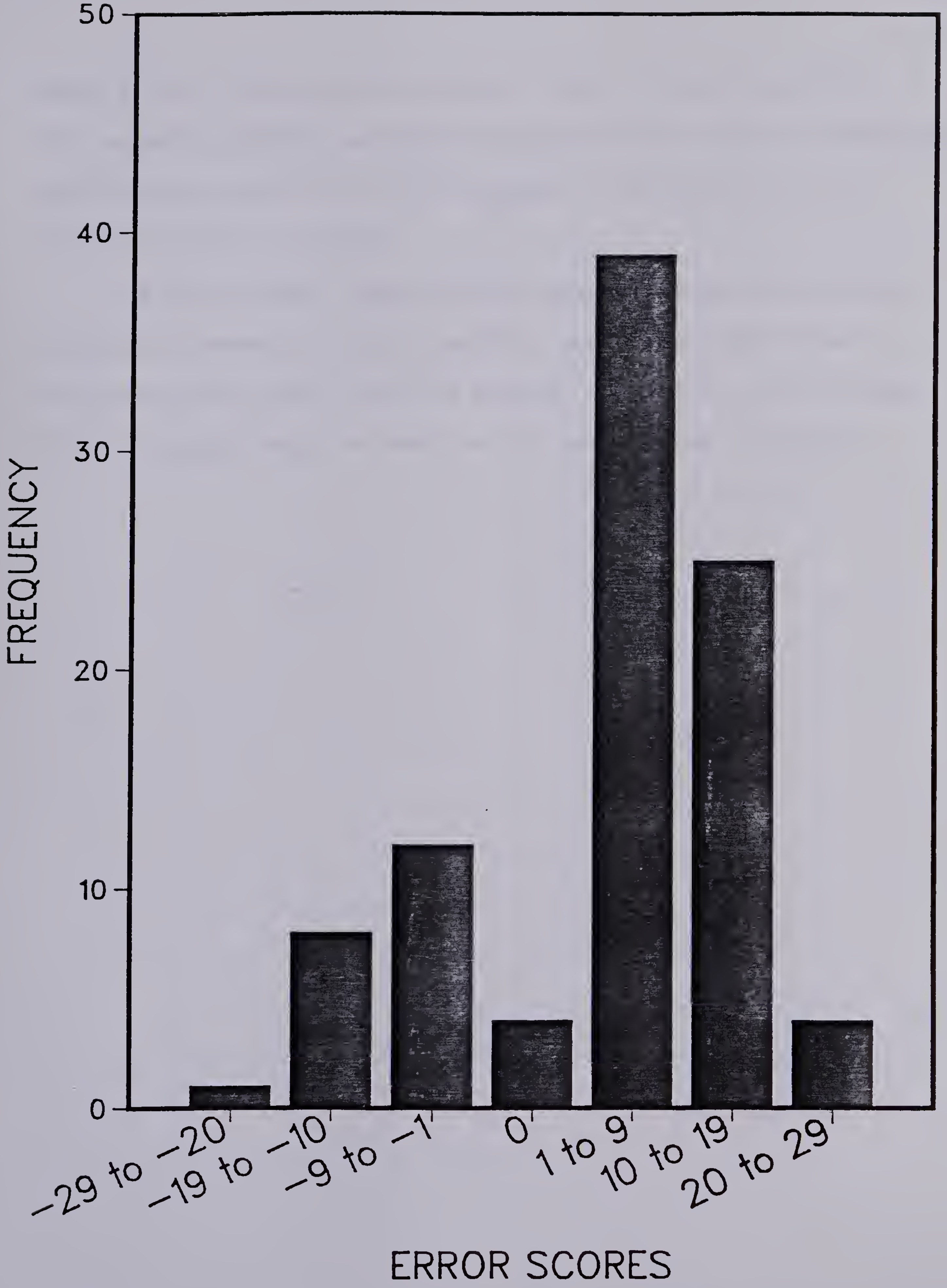

Figure 4.3 DISTRIBUTION OF ERROR SCORES BETWEEN THE SILS AND WAIS-R IQS

points; and those scores greater than +10 error points. A chi-square analysis was performed and the results indicated that there were no sex differences in estimation of IQ (X^2=1.03; df=2; p<.599).

In conclusion, the SILS IQs overestimated the WAIS-R FSIQs by a mean of 4.9 IQ points, and were significantly less variable than the FSIQ scores. As well, 35.5 percent of all scores were in error of 10 or greater IQ points.

Question III:

Does the Standard Progressive Matrices give an accurate estimate of WAIS-R Full Scale IQs?

The analyses comparing the means of the WAIS-R FSIQ and the SPM estimated IQ are summarized in Tables 4.9 and 4.10. The results indicated that there was a significant difference between the WAIS-R FSIQ and the SPM estimated IQ of 9.2 IQ points. The standard deviation of the SPM estimated IQ (11.4) was significantly lower ($t=2.69$; $df=92$; $p < .01$) than that of the WAIS-R FSIQ (13.6).

Previous research has indicated that the SPM correlates negatively with age (Guttman, 1981). For this sample, a negative correlation between the SPM total score and the age of the individual was obtained ($r=-.2384$, $p<.01$). Therefore, the SPM was correlated with the sum of the scaled scores, as well as with the IQ scores on the WAIS-R. Table 4.12 presents the correlations of the SPM total score and estimated IQ with the sum of the scaled scores for the Verbal subtests (VSS), the sum of the scaled scores for the Performance subtests (PSS), the total sum of the scaled scores (TSS), the Verbal (VIQ), Performance (PIQ), and Full Scale (FSIQ) IQs for the WAIS-R.

It can be seen that all the correlations are significant below the .001 level. The largest correlation (.73) is between the SPM estimated IQ and the total sum of

TABLE 4.12

CORRELATION COEFFICIENTS BETWEEN THE STANDARD PROGRESSIVE MATRICES AND THE WAIS-R*

	SPM	Estimated IQ
VSS	.3776	.6997
PSS	.5823	.4971
TSS	.5196	.7302
VIQ	.4015	.5193
PIQ	.5333	.5149
FSIQ	.5451	.6101

*all coefficients significant beyond the .001 level.

the scaled scores, while the lowest correlation is with the SPM total score and the sum of the scaled scores for the Verbal subtests.

Figure 4.4 contains a scattergram of the WAIS-R Full Scale IQs with the SPM estimated IQs. It appears that the relationship between the two IQs drastically deteriorate at both the lower and upper IQ ranges, and that the SPM has a restricted ceiling. As well, it is evident that there is a tendency for the SPM to overestimate the WAIS-R IQs.

Figure 4.5 contains a histogram of the error scores between the predicted IQs and the WAIS-R IQ. The predicted IQs underestimated the WAIS-R IQs by 10 or more IQ points in 3.2 percent of the cases, while 43.6 percent of the predicted IQs overestimated the WAIS-R IQs by 10 or more IQ points (mean=9.14; SD=11.19). This resulted in 46.8 percent of all scores being in error of 10 or more points.

In conclusion, the SPM IQs overestimated the WAIS-R FSIQs by a mean of 9.2 IQ points. 43.6 percent of all the predicted IQs were overestimated by 10 or more IQ points.

<u>SILS and SPM as Estimators of WAIS-R Full Scale IQs.</u>

When both the SPM and the SILS were evaluated as estimators of WAIS-R IQs, the SILS appeared to be the better estimator, as it produced the larger correlation coefficient with the WAIS-R Full Scale IQ (r=.55; r=.74 respectively), and produced a lower mean difference in error scores

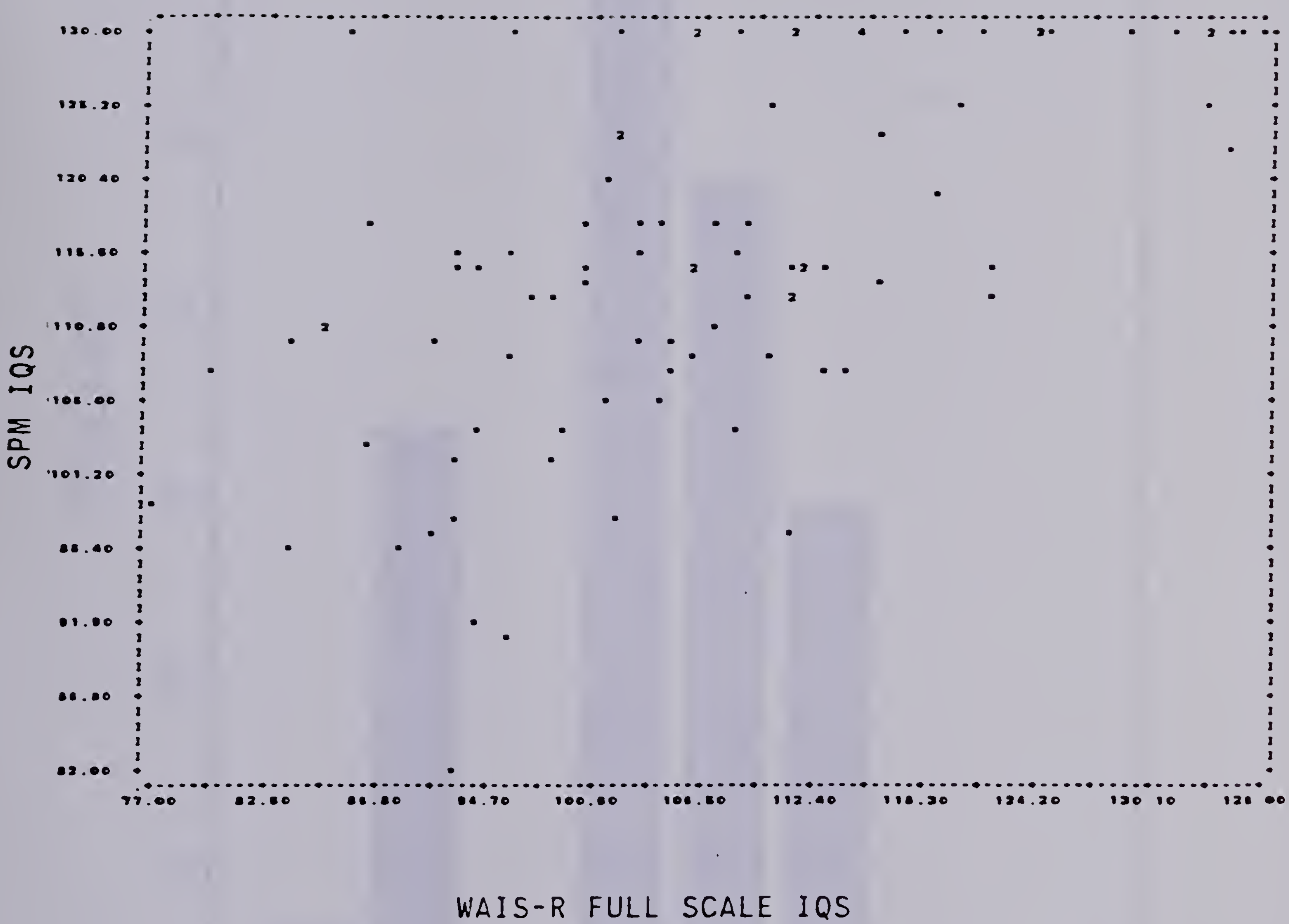

Figure 4.4 SCATTERGRAM OF WAIS-R IQS WITH SPM IQS

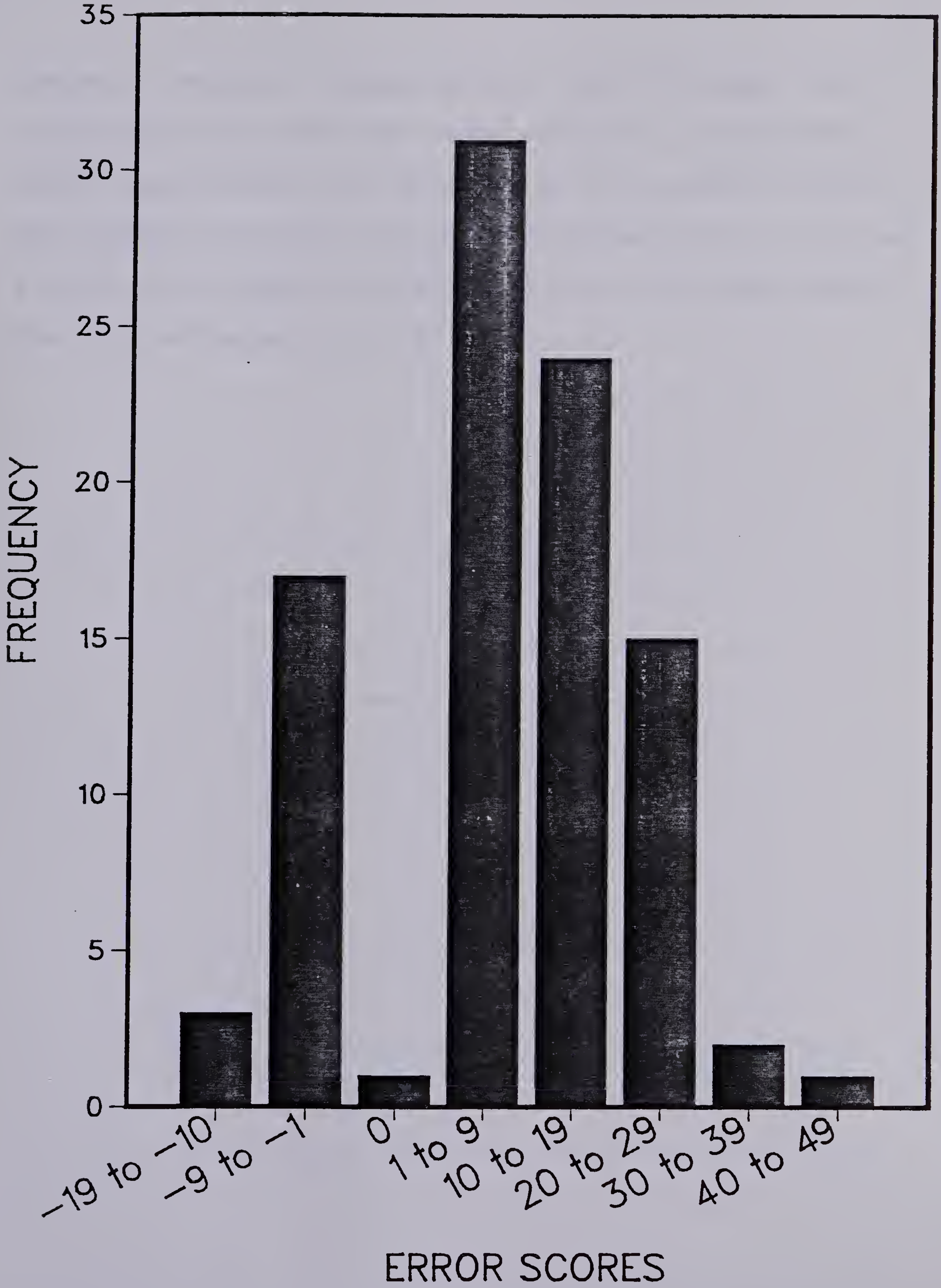

Figure 4.5 DISTRIBUTION OF ERROR SCORES BETWEEN THE SPM AND WAIS-R IQS

(mean=9.2; mean=4.9 respectively). The SPM though, did produce IQ scores that were more variable, and therefore better approximated the variablility of the WAIS-R IQs, as the standard deviation for the SPM estimated IQs (11.4) was significantly higher ($t=5.59$, $df=91$, $p < .001$) than that of the SILS estimated IQs (7.6).

CHAPTER V

DISCUSSION

Relationship between the WAIS-R and SPM

The individuals in the study were classified in terms of three distinct profiles of performance. For those individuals who had well developed verbal and nonverbal skills, the Standard Progressive Matrices score correlated positively with WAIS-R subtests that involved a verbal component. For the individuals with low verbal skills, but well developed nonverbal skills, SPM performance seemed to be related to visual perception, as, the only significant positive correlation coefficient between the SPM and the WAIS-R scores was with the Block Design subtest. For the individuals who were low in both verbal and nonverbal abilities,[5] but whose verbal abilities were better developed, SPM performance seemed to be related to a visual perceptual component, and to immediate memory and sequential processing. The above findings are consistent with Sattler's (1982), Burke's (1974), and Vernon's (1950) statements that the SPM can be solved through either a visual perceptual approach or a verbal analytic approach. These findings also offer some support of Jensen's (1966)

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[5] The discussion of the findings for Cluster III will deal with the analyses after the six people with high verbal skills were removed from the sample.

statement that;

> "A test like the Progressive Matrices, which does not pose problems in the form of verbal stimuli, has less tendency to arouse verbal mediation in subjects who for some reason have a high threshold of arousal. When verbal behavior is not aroused by the task, the subject tries to solve the problem on the perceptual level . . ." (p. 104)

Of interest was the finding that for Cluster I the SPM correlated higher with the Verbal IQ, as opposed to the Performance IQ, but that for Clusters II and III the SPM did not correlate with any of the IQ scores. This could account for some of the inconsistencies in the previous research findings, as, some researchers (Watson & Klett, 1974; McLaurin *et al.*, 1973; McLaurin & Farrar, 1973; Jurjevich, 1967) found the SPM correlated more highly with the Performance IQ as opposed to the Verbal IQ, while other researchers (Bingham, Burke & Murray, 1966; Vincent & Cox, 1974; Burke & Bingham, 1969) found higher correlations with the Verbal IQ. Burke & Bingham commented on their findings as follows:

> "It is interesting to note that the Raven PM missed loading (.36) on Factor E (Perceptual Organization), and, accordingly, as in our previous study, did not appear to be uniquely or clearly significant as a

> measure of this Cohen factor, as we hypothesized it might be . . . Although Factor A, which we regarded as a general factor of intellectual functioning, was highly verbal, the Raven Progressive Matrices loaded on it. One might speculate as to what extent performance on the Raven PM depended on verbal ability" (p. 251).

Their findings, then, are consistent with the results from this study for Cluster I, as for this group, the SPM did not load at all with the Block Design or Object Assembly subtests, which are the best measures of the perceptual organization factor (Blaha & Wallbrown, 1982), but loaded more on a verbal factor.

The Information, Vocabulary and Comprehension subtests have been found to be the best overall measures of *g* among the WAIS-R subtests (Blaha & Wallbrown, 1982). In this study, for Cluster II, the SPM correlated negatively with the Information and Vocabulary subtests, while for Cluster III the SPM correlated negatively with the Vocabulary and Comprehension subtests. These findings contradict the notion that the SPM is a general measure of *g*.

<u>The SILS as a Brief IQ Measure</u>

A correlation of .74 was found between the SILS total score and the WAIS-R IQ. This finding was consistent with results of other research where the minimum correlation

obtained was .73 (Bartz, 1968). It was interesting that the estimated IQ, using Paulson & Lin's age-scaled tables did not improve the relationship between the two measures even though there was, for this sample, a significant correlation between the SILS Vocabulary and Total score with age. This may indicate that Paulson and Lin's tables did not provide an adequate correction for age for this population.

The results of the analyses demonstrated that the SILS IQ overestimated the WAIS-R FSIQ by a mean of 4.9 IQ points, and that the SILS IQs were significantly less variable then the Full Scale IQ scores. Watson & Klett (1968) also found that the SILS overestimated the WAIS IQ and that the variablility of scores was restricted. A scatterplot indicated that the relationship between the SILS and WAIS-R IQs deteriorated somewhat at the lower and upper IQ ranges, and that the SILS reached a low ceiling. This is consistent with Sines (1958) finding of a restricted range on the SILS as a measure of intelligence, and with Watson & Klett (1968) who reported the poor congruency between the WAIS and SILS at the lower IQ ranges.

In all, 35.5 percent of scores were in error of 10 or greater IQ points with 25.8 percent of the errors being in the direction of overestimation. One possible cause for the overestimation of scores may, in part, be due to the fact that the tables provided estimated WAIS IQs. WAIS-R FSIQs

tend to be, on the average, eight points lower than the WAIS FSIQ IQs.

There were no sex differences found in predicting WAIS-R IQs using Paulson & Lin's tables. This is consistent with Paulson & Lin's (1970) finding of no sex differences, but contradicts Pauker's (1975) finding where he found that women's predicted IQs tended to be higher than the WAIS IQs, while men's predicted IQs tended to be lower.

In summary, it appears from these findings that, if the SILS is to be used as a brief estimate of IQ, new transformation tables that correct for difference in variability and in overestimation are needed.

The SPM as a Brief IQ Measure

A correlation of .55 was found between the SPM total score and the WAIS-R Full Scale IQ. This correlation was consistent with Watson & Klett (1974) who reported a correlation of .58 between the SPM and the WAIS. However, Bingham, Burke & Murray (1966), and Shaw (1967) reported higher correlations of .85 and .83 respectively between the two measures.

Of interest was the finding that there was a large increase in the correlation coefficent when the SPM IQ was correlated with the sum of the scaled scores for the Verbal subtests, and the sum of the scaled scores across all the the subtests (r=.70, r=.73 respectively). This indicates

that there is a stronger relationship between the WAIS-R Verbal and Full Scale IQs with the SPM when only the SPM has been adjusted for age effects. The adjustment for age operates in the following manner; a 24 year old person who, on the WAIS-R, obtained a sum of the scaled scores for the Verbal subtests of 60 would achieve a Verbal IQ of 101, while a person of 34 years with the same score would achieve a Verbal IQ of 97. Conversely, on the SPM, a 24 year old person with a raw score of 50 would achieve an estimated IQ of 110, while a 34 year old with the same raw score would achieve an estimated IQ of 115. It seems, then, that Peck's (1970) conversion tables have overcompensated for age effects.

The results of the analyses also indicate that the SPM IQs overestimated the WAIS-R IQs by a mean of 9.2 IQ points, with 43.6 percent of the predicted IQs overestimating the WAIS-R IQs by 10 or more IQ points. This supports the previous criticism, noted by Vincent & Cox (1974), that the SPM overestimates IQ scores. Since the SPM IQs were estimating WAIS IQs, the tendency to overestimate may, in part, be due to the fact that the WAIS-R IQs tend to be lower than WAIS IQs.

Scatterplots indicated that the relationship between the SPM and the WAIS-R IQ drastically deteriorated at both the lower and upper IQ ranges, and that the SPM had a

restricted ceiling. A restricted ceiling has also been one of the other criticisms of the SPM (Vincent & Cox, 1974).

It appears from these findings, that the correlation between the SPM and the WAIS-R was not high enough to recommend that it be used as a substitute for the WAIS-R. The increase in the correlation when the estimated IQ was correlated with the sum of the scaled scores, indicated that if tables could be devised to provide more accurate transformations, correcting for age effects and overestimation, this measure might be more useful for this purpose.

The SILS and SPM as Brief IQ Measures

When both the SPM and the SILS were evaluated as estimators of WAIS-R IQs, the SILS seems to be the better estimator as it resulted in the largest correlation with the WAIS-R Full Scale IQ and produced a lower mean difference in error scores. Pringle & Haanstad (1971) also found a higher correlation between the SILS and the WAIS as compared to the SPM and the WAIS.

Implications for Further Research

The question of what the Standard Progressive Matrices actually does measure needs to be further explored as the SPM is frequently used as an assessment tool. The results from the present study indicate that people with different profiles of ability seem to use different skills to solve

the SPM items. Future research projects should focus on confirming or disconfirming this finding by replicating this study in different populatons using a larger sample size. As well, a cluster of people with high verbal skills but low nonverbal skills should be included in order to examine if people with this type of profile approach the items differently than, for example, people with both high verbal and high nonverbal abilities.

If the results of the present study are confirmed, that is, different factor structures emerge depending upon the profile of abilities of the individuals within each cluster, then research studies should be directed towards defining more precisely how the SPM is solved by the individuals in each of the clusters. One of the problems with past research projects is that they have attempted to establish what the SPM measures without allowing for the possibility that the test may not measure the same ability for all people. As indicated earlier, this could account for some of the contradictory findings. For example, some authors (Deutsch, Katz & Jensen, 1968) have suggested that performance on non-verbal tasks of intellectual ability actually require spontaneous verbalisation by the individual. The "Verbalisation Hypothesis" has been tested with the Progressive Matrices using people who have incurred brain damage. Such investigations are based on the

hypothesis that the left hemisphere is associated with verbal functions in a right-handed person. If the "Verbalisation Hypothesis" is true, one would expect poorer performance on the Progressive Matrices for people with left-hemisphere brain damage. The results of the studies, though, have been conflicting. Arrigoni & De Renzi (1964) found that left brain damaged people performed worse than right brain damaged subjects on the Colored Progressive Matrices, Piercy & Smyth (1962) found lower scores on the SPM for right dyspraxic patients than for left dyspraxic patients, and Colonna & Fagioni (1966) found no differences on SPM performance between people who had right or left hemisphere brain damage. One of the reasons for these conflicting results may be that prior to the brain injury, the individuals in these studies did not have the same profiles of abilities. Therefore, it may not be appropriate to compare the findings.

Future research studies examining brain injury and performance on the SPM, should select samples where a record of the person's profile of abilities before the brain injury is available. Based on the findings of the present study, and if future research confirms the findings, one would expect that an injury to the left hemisphere would affect the performance on the SPM for people with high verbal skills and high nonverbal skills prior to injury, but not

the people with low verbal skills and high nonverbal skills. In undertaking this form of research though, one must be aware of the problem of completely separating the functions of the two hemispheres and considering them as totally independent units (Piercy, 1964).

If the results from the present study are replicated, subsequent research projects might determine different profiles of abilities by administering a short-form of the WAIS-R to individuals using the Vocabulary and Block Design subtests as measures of verbal and nonverbal ability, respectively. One method for examining the individuals approach to the SPM, could involve having the individuals "think out loud" as they solve the items, and then analyzing whether the verbalizations are qualitatively different between the individuals in each cluster.

In terms of utilizing the SILS as a brief IQ measure, other researchers will have to provide further research to support its validity as an estimate of WAIS-R IQs with different populations. Evidence from this study indicated that new conversion tables are needed that would produce greater variability among the IQ scores, and would tend towards lower IQ estimates.

<u>Conclusion</u>

In summary, the results of this study provide some evidence to support the hypothesis that the Standard Progressive Matrices behaves differentially as an assessment tool depending upon the population with which it is used. Until further research establishes a more precise understanding of what the SPM measures for different groups of people, the results obtained from the use of the SPM must be interpreted cautiously.

The utilization of the SPM as a brief intelligence measure is deemed inappropriate in view of the low correlation with the WAIS-R and in light of the finding that for some individuals the SPM related to WAIS-R IQ scores but for other groups of people there was no relationship.

The Shipley Institute of Living Scale has gained wide usage in educational and institutional settings as a brief intelligence measure. Tables available for converting the SILS score into an IQ equivalent are based on research with the WAIS. The results from this study indicate that one of the more commonly used conversion tables may no longer be suitable to estimate WAIS-R FSIQs, and that new tables should be developed that provide more accurate IQ approximations.

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APPENDIX A

DISTRIBUTION OF THE SAMPLE BY DEMOGRAPHIC CHARACTERISTICS

Tables X - XV

TABLE X
DISTRIBUTION OF THE SAMPLE BY SEX

SEX:	Grant McEwan	Clinic Referral
Male	19 (40.4%)	24 (51.1%)
Female	28 (59.6%)	23 (48.9%)

TABLE XI
DISTRIBUTION OF THE SAMPLE BY EDUCATION

EDUCATION:	Grant McEwan	Clinic Referral
Grade 8 or less		2 (4.3%)
Grade 9 - 11		11 (23.4%)
High School Graduate		6 (12.8%)
Some Post-secondary Education	47 (100%)	16 (34.0%)
Technical Institution Diploma		4 (8.5%)
Community College Diploma		2 (4.3%)
University Degree		6 (12.8%)

TABLE XII
DISTRIBUTION OF THE SAMPLE BY OCCUPATION

OCCUPATION:	Grant McEwan	Clinic Referral
Student	47 (100%)	15 (31.9%)
Professional/ Technical		5 (10.6%)
Secretarial/ Sales/Clerk		7 (14.9%)
Rehabilitation Counsellor		2 (4.3%)
Semi-skilled		7 (14.9%)
Unskilled		4 (8.5%)
Homemaker		6 (12.8%)
Unemployed		1 (2.1%)

TABLE XIII
DISTRIBUTION OF THE SAMPLE BY CURRENT EMPLOYMENT

CURRENT EMPLOYMENT	Grant McEwan	Clinic Referral
Full-time		16 (34.0%)
Part-time		3 (6.4%)
Homemaker		6 (12.8%)
Unemployed		7 (14.9%)
Full-time Student	47 (100%)	15 (31.9%)

TABLE XIV
DISTRIBUTION OF THE SAMPLE BY FIRST LANGUAGE

FIRST LANGUAGE ENGLISH	Grant McEwan	Clinic Referral
Yes	38 (80.9%)	43 (91.5%)
No	9 (19.1%)	4 (8.5%)

TABLE XV
DISTRIBUTION OF THE SAMPLE BY REFERRAL REASON

REFERRAL REASON:	Grant McEwan	Clinic Referral
Volunteer	47 (100%)	14 (29.8%)
Personal Interest		7 (14.9%)
Academic/Learning Difficulties		16 (34.0%)
Vocational		10 (21.3%)

APPENDIX B

ONEWAY ANALYSIS OF VARIANCE
WAIS-R SCORES, SPM BY CLUSTERS

TABLE XVI

TABLE XVI
ONEWAY ANALYSIS OF VARIANCE
WAIS-R SCORES, SPM BY CLUSTERS

SOURCE	CLUSTER MEANS					Post Hoc Comparisons*		
	Mean1	Mean2	Mean3	F**	Sig.	1 vs 2	1 vs 3	2 vs 3
Inf	10.85	7.84	8.38	15.30	<.01	*	*	
DSp	11.55	8.80	9.34	13.35	<.01	*	*	
Voc	13.03	8.72	9.72	39.21	<.01	*	*	
Ari	12.35	9.56	9.52	20.97	<.01	*	*	
Com	14.20	9.60	11.00	35.61	<.01	*	*	
Sim	13.38	8.68	9.93	37.04	<.01	*	*	
PC	11.45	11.88	8.66	23.54	<.01		*	*
PA	12.08	12.08	9.24	12.87	<.01		*	*
BD	12.53	12.08	8.28	38.51	<.01		*	*
OA	11.48	10.80	7.83	22.95	<.01		*	*
DSy	12.25	10.48	8.17	22.32	<.01	*	*	*
VIQ	117.65	95.52	99.41	52.05	<.01	*	*	
PIQ	115.25	112.16	89.83	70.20	<.01		*	*
FIQ	118.50	102.16	94.45	71.20	<.01	*	*	*
SPM	54.80	51.00	46.17	26.20	<.01	*	*	*

* Scheffe procedure; * denotes pairs of groups significantly different at the .05 level.
** df=2,91

APPENDIX C

CHI-SQUARE ANALYSIS
DEMOGRAPHIC VARIABLES BY CLUSTERS

TABLES XVII - XXIII

TABLE XVII
CLUSTER BY SAMPLE

	SAMPLE	
	Grant McEwan	Clinic Referral
Cluster 1	20 (42.6%)	20 (42.6%)
Cluster 2	16 (34.0%)	9 (19.1%)
Cluster 3	11 (23.4%)	18 (38.3%)
Chi-square = 3.65 df = 2 p<.16		

TABLE XVIII
CLUSTER BY SEX

	SEX	
	Male	Female
Cluster 1	16 (37.2%)	24 (47.1%)
Cluster 2	16 (37.2%)	9 (17.6%)
Cluster 3	11 (25.6%)	18 (35.3%)
Chi-square = 4.60 df = 2 p<.10		

TABLE XIX
CLUSTER BY OCCUPATION

	OCCUPATION*			
	Student	Professional	Semi-skilled	Unskilled
Cluster 1	27 (43.5%)	5 (100%)	5 (31.3%)	3 (27.3%)
Cluster 2	22 (35.5%)	0 (0.0%)	2 (12.5%)	1 (9.1%)
Cluster 3	13 (21.0%)	0 (0.0%)	9 (56.3%)	7 (63.6%)

Chi-square = 21.29 df = 6 $p<.002$
*66.7% of cells had expected frequencies less than 5.
Therefore these results must be viewed tentatively.

TABLE XX
CLUSTER BY EDUCATION

	EDUCATION		
	High School or less	Some Post-Secondary	Diploma/ Degree
Cluster 1	6 (31.6%)	25 (37.9%)	9 (75.0%)
Cluster 2	5 (26.3%)	20 (31.7%)	0 (0.0%)
Cluster 3	8 (42.1%)	18 (28.6%)	3 (25.0%)

Chi-square = 8.47 df = 4 $p<.08$

TABLE XXI
CLUSTER BY REFERRAL REASON

	REFERRAL REASON*		
	Volunteer/ Interest	Academic Problems	Vocational Referral
Cluster 1	33 (48.5%)	1 (6.3%)	6 (60.0%)
Cluster 2	17 (25.0%)	6 (37.5%)	2 (20.0%)
Cluster 3	18 (26.5%)	9 (56.3%)	2 (20.0%)

Chi-square = 11.34 df = 4 p<.02
*55.6% of cells had expected frequencies less than 5.

TABLE XXII
CLUSTER BY FIRST LANGUAGE

	FIRST LANGUAGE*	
	English	Not English
Cluster 1	37 (45.7%)	3 (23.1%)
Cluster 2	19 (23.5%)	6 (46.2%)
Cluster 3	25 (30.9%)	4 (30.8%)

Chi-square = 3.51 df = 2 p<.17
*33.3% of cells had expected frequencies less than 5.

TABLE XXIII
CLUSTER BY WHETHER ENGLISH WAS SPOKEN FLUENTLY

	ENGLISH SPOKEN FLUENTLY* Yes	No
Cluster 1	2 (25.0%)	1 (20.0%)
Cluster 2	3 (37.5%)	3 (60.0%)
Cluster 3	3 (37.5%)	1 (20.0%)

Chi-square = .677   df = 2 $p < .71$
*100% of cells had expected frequencies less than 5.
Based only on those people who reported English was not their first language.